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ABSTRACT

A study investigated the types of writing assignments commonly found in undergraduate natural sciences and engineering courses. The study was used as a basis for the development of composition courses for limited-English-speaking students in these fields, the most popular fields of study among foreign students. Eighty take-home assignments given in 17 courses from 12 subject departments in the natural sciences and engineering fields at the University of Texas were classified according to writing task type and the skills required to complete the assignment. It was found that 75% of the writing tasks were "lab reports," and summary and paraphrase were the dominant skills needed to write the "lab reports." Lower division English composition textbooks were then examined to see if they addressed these skills adequately. One book was found to meet this need, but most textbooks did not. It was concluded that separate composition classes should be provided for foreign students majoring in the natural sciences and engineering fields and that these courses should de-emphasize research paper writing and place greater emphasis on development of summary and paraphrase skills. (MSE)

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Writing in the Natural Sciences and Engineering: Implications for ESL Composition Courses

George Braine

This presentation is based on my dissertation research, in which I collected and analyzed take home-assignments from undergraduate courses in the natural sciences and engineering (NS and E). My aim was to relate the writing tasks of these disciplines to composition courses for ESL students, especially at the lower-division level.

I will first explain my reasons for focusing on the NS and E. I will then discuss my method for determining the writing tasks in these disciplines. Finally, I will discuss my research and its pedagogical implications.

The natural sciences and engineering, along with pre-business, appear to be the most popular majors of foreign students. According to the Institute of International Education (IIE), more than 40 % of the foreign students at American universities major in these areas (Zikopoulos & Julian, 1986). At the undergraduate level, the percentage may be even higher. At The University of Texas at Austin (UT), where the student population is over 50,000, about 55 % of the foreign undergraduate students are enrolled in the College of Natural Sciences and the Collge of Engineering.

The second reason for focusing on the NS and E is that these two areas share common norms, conventions, and rhetorical strategies, and are therefore compatible enough to be considered a single discourse community. Students in these areas share a knowledge of science and mathematics. Further, Noll (1964) has contrasted the precise nature of the scientific method with the subjective nature of the humanities method. Trimble (1985), who analyzed scientific and technical writing, has defined such discourse as concerned with the presentation of facts and hypothesis, and not with forms of English that editorialize, express emotion, or is fictional or poetic in nature. In the academic community, we can easily tell a botanist from a sociologist, an engineer from a social scientist.

Thus, the large population of students who major in the NS and E and the compatible nature of their discourse justifies my focus on these disciplines, especially for pedagogical purposes.

Now, a discussion of my method. Numerous researchers, usually from English departments, have conducted academic writing task surveys. Using questionnaires, some researchers have surveyed faculty, and others have surveyed students. Among the most often quoted studies are that of Behrens (1978), who surveyed 128 faculty members at the American University in Washington DC; Kroll (1979), who surveyed both American and foreign students enrolled in freshman English courses at the USC; Ostler (1980), who surveyed 133 foreign students ranging from freshmen to doctoral candidates, also at USC; and Bridgeman and Carlson (1984), who conducted what is perhaps the the widest ranging survey--among 190 faculty from 34 American and Canadian universities.

The analysis of assignment handouts or writing samples prior to determining the writing tasks appears to be the most logical approach. However, all the researchers quoted above had done the opposite: they had sent out questionnaires to faculty and students with lists of pre-conceived writing tasks, thereby imposing these terms on the respondents (Horowitz, 1986). Table 1 shows the variety of terms used by the researchers to identify writing tasks from the NS and E.

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Table 1
Terms Used to Identify Natural Sciences and Engineering* Writing Tasks on Questionnaires

Researcher	Labels use
Behrens (1978)	reports; themes or essays; research papers
Kroll (1979)	papers integrating mathematical or statistical data with reports; reports of lab experiments in continuous discourse; term papers
Ostler (1980)	lab experiments; book reviews; research proposals; research papers
Eblen (1983)	lab reports; documented papers; technical reports; analytical papers
Bridgeman & Carlson (1984)	lab reports; article summaries; research papers; expository/critical writing; group writing; case studies
Wallace (1985)	article summaries; article abstracts; group writing tasks; case studies; analysis papers; comparison/contrast papers; documented research papers; lab reports

* The focus of these research was not on NS and E areas.

Now, compare the above terms with the following, used by faculty in the NS and E at UT at Austin.

> abstract; article review; article summary; essay; final report; lab report; memorandum; progress report; proposal; research article; research paper; standard experiment; technical report; topic review (Braine, 1989).

In fact, faculty from separate disciplines may use different terms to identify what is essentially the same task. For instance, the report on a lab experiment was called "a standard experiment" in chemical engineering, a "final" or "progress" report in aerospace and petroleum engineering, a "technical report" in mechanical engineering, and a "memorandum" in electrical engineering. Imagine the confusion that can result! I therefore have serious misgivings about using questionnaires in academic writing task surveys. [See Braine (1988) for a comprehensive critique of academic task surveys.]

Two researchers, Rose (1983) and Horowitz (1986) have used the more logical approach, analyzing assignment handouts before determining writing tasks. However, in my view, Rose's study, conducted at UCLA, has one shortcoming. His sample contained both examination and non-examination assignments. Usually, examinations only require the recall of information, with the emphasis being on content; little attention is paid to format, organization and style, which take-home assignments stress. Consider the elaborate lab manuals and sample reports that are supplied tro students. Rose's decision to place the two types of assignments in one category may not therefore be valid.

Horowitz's (1986) sampled only take home assignments, and further, explicitly described his taxonomy, which he called "task categories." For instance, one category, which he called *Report on a specified paricipatory experience* , was defined as follows.

> None of the data needed to be obtained from a reading. . . . Students were assigned a specific "scene", either to observe passively or to participate in . . . They were also armed with a list of things to look for in that scene and a framework within which to interpret what they observed. The writing tasks involved reporting details of the experience . . . and the coming to a conclusion . . . [which] was typically an answer to an explicit question. (Horowitz, 1986)

Lab reports belong to the above category. But, unlike "lab report," a term which may eveoke defferent scenarios in varying contexts, Horowitz's defines the activities that are required to perform the task, and the framework within which the task has to be performed.

The only shortcoming in Horowitz's method is that his sample included assignments from a variety of disciplines ranging from the humanities to the natural sciences. This is contrary to the concept that each discipline is a separate discourse community, with its own norms, conventions and rhetorical strategies.

For my study, I used Horowitz's approach, classifying the assignments I collected according to tasks, but concentrating only on the NS and E, two compatible disciplines.

In the Sping and Fall semesters of 1988, I collected 80 take home assignments given in 17 undergraduate courses from 12 subject departments at the College of Natural Sciences and the College of Engineering at UT.
(See Table 2)

Table 2
Distribution of Assignments According to Subject Departments

Department	Course Title	No. of Assignments
Natural Sciences		
Botany	Lab Methods in Cell Biology	10
Chemistry	Advanced Analytical Chemistry	02
	Physical Methods for Biochemistry	02
Home Economics	Intro. to Home Economics Education	05
Microbiology	Microbiology 301	03
Physics	Quantum Phenomena	05
Geology	Mineral Resources	02
	Total	29
Engineering		
Aerospace	Design & Testing of Aerospace Structure	02
Chemical	Che. Eng. Fundamentals lab	09
	Process and Projects Lab	05
Civil	Eng. Economy & Construction Management	03
	Professional Eng. Management	03
	Contracts & Specifications	01
Mechanical	Mechanical Measurements	06
Petroleum	Petrophysics & Fluid Flow	10
	Petroleum Eng. Design	06
Electrical	Electrical Eng. Projects Lab	06
	Total	51

The classification (using Horowitz's approach) yielded 4 task categories. (Table 3)

Table 3
Assignments According to Task Categories

Task Category	No. of Assignments	% of sample
Summary of /reaction to a reading	06	07
"Lab Report"	59	74
Case Study	08	10
Research Paper	04	05
None of the above	03	04

Since the overwhelming majority of tasks belonged to the "lab report" category, I also collected and analyzed lab reports from seven areas mentioned in Table 2: Botany and Physics from the NS, and Aerospace, Chemical, Mechanical, Petroleum, and Electrical from Engineering. I wanted to determine what writing activities were most required in these reports. A typical "lab report" is structured as Abstract, Introduction, Theory, Apparatus & Procedure, Results, and Conclusions/Discussion. The structure of a lab report with the related activities for each stage, is given below.

Table 4
Structure of a "Lab Report"

Section of Report	Required Activities
Abstract	*summarize* entire report. Only summary required.
Introduction	*state* purpose of experiment; "review" theory; summarize experimental procedure; state results. (information has to be transferred from "lab notes" i.e. assignment handout) Mainly summary and paraphrase required.
Theory	*explain* assumption(s)/principle(s) that underlie experiment [explain functions of apparatus, theory behind method being used, method used for determining data] (information has to be transferred from assignment handout) Mainly summary and paraphrase required.
Apparatus & Procedure	*describe* apparatus used. describe experimental procedure. (information transferred from assignment handout) Mainly summary and paraphrase required.
Results	*present*, discuss, analyze results of experiment. compare results with previous (published) work. (largely independent of information in assignment handout.) But see Kiniry and Strenski 1985: "discussion" and "analysis" largely requires summary of information. Summary still required
Conclusions/Discussion/ Recommendations	*analyze* and interpret data. (largely independent of assignment handout) Summary or paraphrase may not be the priority.

What we loosely term a "lab report" actually requires a complex mixture of writing activities: summary, paraphrase, seriation, description, comparison and contrast, cause and effect, interpretation, analysis, and the integration of mathematical and scientific data into the text. However, what figures overwhelmingly are summary and paraphrase.

To recap, about 55% of the foreign undergradaute students at UT at Austin major in the NS and E; 75% of the writing tasks in these areas are "lab reports"; and summary and paraphrase appear to be the dominant skills needed in writing "lab reports".

Teachers in the NS and E complain that their foreign students' papers are mostly "cut and Paste" jobs, a claim substantiated by Abraham (1987), who analyzed 64 papers written by foreign students in a technical writing class. 36 papers showed clear instances of plagiarism. According to Abraham, several students who managed to avoid copying did so ata terrible price: "they produced paraphrases that obscured or altered the meaning of their sources. At least one student created a paraphrase that expressed the exact opposite of what his source had said. Other students created paraphrases that were utterly incomprehensible" (p.53). Brogan & Brogan (1982), who also investigated the technical writing of foreign students, say that a typical foreign engineering student may define a term paper as a collection (not an amalgamation) of research. Thus, the student may not hesitate to copy entire sections of research reports.

In order to find out what was going on in ESL composition courses at the lower-division level, I examined some textbooks used in Freshman English and other classes. The first book, *Refining Composition Skills*, is used at UT in Freshman English classes for foreign students. In a text running to 400 pages, not one example, explanation or an exercise in summary or paraphrase was included. in *Read, Write, Revise: A Guide to* ***Academic*** *Writing* (emphasis mine), paraphrase is not even mentioned, and summary is presented and practiced in two pages. (The text is over 300 pages long.) *A Handbook of Technical Writing*, which is meant for both American and foreign students, does not mention summary and paraphrase. Only *Academic Writing: Working in Sources Across the Curriculum* (by Mary Lynch Kennedy and Hadley M. Smith, Prentice-Hall), is summary and paraphrase given their due place: 41 pages are assigned to summary and 36 pages to paraphrase.

What are the pedagogical implications of all this. First, the large percentage of foreign students majoring in the NS and E, who appear to belong to a single discourse community, suggest that separate composition classes (in pre-University intensive English programs as well as at lower-division level) be formed for such students. When a university has a College of Natural Sciences and a College of Engineering, the presence of a large number of foreign students who major in these areas can almost be taken for granted. Since all these students are required to take Freshman English (and occasionnaly other writing courses also), the formation of such classes is further justified. Second, these courses should emphasize summary and paraphrase skills. Naturally, this also means that informed decisions have to be made in the selection of textbooks. Third, Freshman English courses often emphasize the Library Research Paper assignment, mostly because this assignment is considered to be the nearest approximation of academic writing practiced in the class. But, as Table 3 shows, Research papers compose only 5% of the assignments from the NS and E. This suggests that, at least in composition classes for students from the NS and E, the Research paper assignment could be deemphasized, and time used for summary and paraphrase instead.

I would like to conclude with a statement about the importance of this type of research. In a recent essay which examined the role of English departments in academic writing instruction, Blair (1988) says that English departments, because they impose their own "brand" of writing on students from other disciplines should have no special role in academic writing instruction--not even in Freshman English. Blair suggests that faculty from other disciplines should be responsible for writing instruction within each discipline.

Although the writing across the disciplines (WAC) movement (which encourages teachers from all discplines to make writing part of the teaching and learning process in their courses) have been in existence for some time, Fulwiler (1984) contends that "increased teaching loads, large classes, administrative responsibilities, lack of collegial support, pressure to research,

publish [in their own disciplines], write grants" (p.115) may prevent faculty from practicing writing instruction. In fact, my observations of WAC courses at UT at Austin have shown that the emphasis is on the product (assigning grades to students' papers) than on teaching the writing process. Thus, the teaching of academic writing is still largely the English departments' responsibility, and these lower-division composition courses may be the last opportunity for many of our students to learn academic writing. Research such as mine would provide English teachers insights into the writing in other disciplines, which they can transfer to academic writing instruction.

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